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We successfully expanded the field of "DNA Computers" to RNA to develop and execute a general approach for the solution of Satisfiability problems. A challenge to this field has been the need for a design that is scalable to more difficult computations.

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DNA Computation: The Search for the "Killer" application

We successfully expanded the field of "DNA Computers" to RNA to develop and execute a general approach for the solution of Satisfiability problems. A challenge to this field has been the need for a design that is scalable to more difficult computations. In Faulhammer *et al.* (2000) we presented a scalable approach to computing by expanding the field of DNA computers to RNA, which can be cleaved in several parallel ways, and we used this approach to solve the most difficult problem to date using either molecular or quantum computing. As a demonstration of a general solution to a wide class of mathematical search problems, we solved a 9-bit instance of a satisfiability problem derived from chess, which the founder of this field regards as "the world champion so far" (Adleman in *Science* 2000, 287:1182). Using specific ribonuclease digestion to manipulate strands of a 10-bit binary RNA library, we developed a molecular algorithm and applied it to a 3×3 chessboard as a 9-bit instance of this problem. Here, the nine spaces on the board correspond to nine 'bits' or placeholders in a combinatorial RNA library. We recovered a set of 'winning' molecules that describe solutions to this problem.

Publications associated with award

Faulhammer, D., Cukras, A. R., Lipton, R. J. and L. F. Landweber (2000) Molecular Computation: RNA Solutions to Chess Problems. Proc. Natl. Acad. Sci. USA. 97:1385-1389.

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Cukras, A. R., Faulhammer, D., Lipton, R. J. and L. F. Landweber (1999) Chess Games: A Model for RNA Based Computation. In DNA Based Computers IV, L. Kari, ed. *Biosystems* 52:35-45.

Faulhammer, D., Lipton, R. J. and L. F. Landweber (1999) Counting DNA: Estimating the complexity of a test tube of DNA. In DNA Based Computers IV, L. Kari, ed. *Biosystems* 52:193-6.

Landweber, L. F., Lipton, R. J. and M. O. Rabin. (1999) DNA^{2}DNA Computations: A Potential "Killer App"? In DNA Based Computers III, H. Rubin and D.H. Wood, eds. DIMACS Series in Discrete Mathematics and Theoretical Computer Science, American Mathematical Society, vol 48, 161-172.

Landweber, L. F. and R. J. Lipton. (1997) DNA^{2}DNA Computations: A potential 'killer app'? In *24th International Colloquium on Automata, Languages and Programming (ICALP)*, Lecture Notes in Computer Science, pages 672-683, Springer-Verlag.

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